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TO:	Examiner Kim Lewis
COMPANY:	United States Trademark and Patent Office
FAX NO.	571 ~~703~~-273-4796; 703-872-9306
FROM:	Jeffrey M. Kaden, Esq. [he]

We are sending a communication of 11 pages (including this cover sheet). Please call (212) 684-3900 immediately if transmission is interrupted or of poor quality.

REF:4738/003 DATE: January 18, 2005

Re: U.S. Patent Application Serial No.: 10/757,014
Title: SCAB PROTECTING BANDAGE
(Our Ref.: 4738/003)

Dear Examiner Lewis:

In connection with our telephone interview of tomorrow, enclosed please find:

1) Burlington web page identifying air porosity as measuring the volume of air, in cubic feet, that will pass through a fabric in one minute.

2) Alluniforms web page identifying various fabrics -- air porosity for these fabrics is set forth in cfm/ft^2 where cfm=cubic feet per minute.

3) Test method for air permeability (air porosity) of textile fabrics -- air permeability/air porosity is expressed as ft^3/min/ft^2.

Very truly yours,
GOTTLIEB, RACKMAN & REISMAN, P.C.

Jeffrey M. Kaden

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faqs

Glossary of Relevant Tests by Cleanroom Market

Pharmaceutical / Microelectronic

1. ***Suter:*** This test measures the ability of a woven fabric to resist hydrostatic pressure. A coverall in use ma be exposed to chemicals in liquid form, in which case it is important to provide a level of protection to the we from these chemicals. These fabrics are not liquid-proof and are not intended for use as protection against hazardous substances. The higher the Suter value, the better.

2. ***Pore Size:*** This test measures the average diameter of the interstices of a fabric in microns. Pore size can used to determine the maximum size of a particle that may pass through a cleanroom garment. Generally, th smaller the pore size, the better. Pore size is a good, relatively quick, measure of the filtration ability of a fabr but an even better test to measure the performance of a fabric in actual cleanroom usage is the Body Box te **See "How Should Fabric Filtration be Measured?" below.**

3. ***WVT and Air Porosity:*** WVT (water vapor transmission) and Air Porosity are tests that are used to meas the relative comfort of a fabric. WVT is the simulated measure of the amount of body moisture that will pass through a fabric in a 24-hour period. Air Porosity measures the volume of air, in cubic feet, that will pass thro a fabric in one minute. The greater the WVT and Air Porosity, the more comfortable a fabric will be; however, Porosity will be limited by Pore Size.

4. ***Helmke Drum:*** This is a device used to count the number of available or releasable particles on a cleanro garment. Particles between 0.1 - 5.0 microns are the usual size of particles on a fabric. For cleanroom classification of fabrics/garments, released particles equal to or greater than 0.5 microns are counted. The lo the count of these particles, the better. The number of particles counted by the Helmke Drum can determine i the fabric has been properly laundered. It can also show if the fabric is degrading.

5. ***Static Decay and Surface Resistivity:*** These tests measure the electrical characteristics of ESD control fabrics for use in microelectronic environments. These fabrics are designed to provide a controlled release of electrical charge that will not damage sensitive circuitry. Static Decay is the speed of the charge-draining of materials. The faster the decay time, the better. Surface Resistivity measures the resistance of electrical flow over or through a fabric in ohms. The Surface Resitivity of fabrics used in ESD controlled areas should be between 105 - 1010 megaohms. The lower the Surface Resistivity (the closer to 105), the better a charge is dissipated, and the greater the ESD protection.

6. ***PFE (Particle Filtration Efficiency):*** The PFE test proposes to measure the number of particles of a give size that will pass through a fabric. Because the PFE test procedure is not performed in a controlled environment that will expose a fabric sample to equal conditions at all times, it cannot provide repeatable res from different test periods. This invalidates any results that are generated from this testing. Pore size is a bet measure of the efficiency of a fabric to resist the penetration of particles through a fabric, and the Body Box t is an even superior measure. **See "How should fabric filtration be measured?" below.**

7. ***Water Repellency (Spray Test):*** The Spray test measures the resistance of a fabric to wetting by water. I especially useful to determine the effectiveness of a water repellant finish applied to a fabric. The higher the Spray rating, the better.

8. ***Body Box (Particle Containment Test):*** Body Box testing measures the relative differences between various cleanroom fabrics in apparel form. The test consists of a test subject performing the "March and Tou and the "Deep Knee Bend" activities in an enclosed clean area about the size of a telephone booth. Air is blo downward on the subject and released particles at 0.5 microns or greater are then counted by a laser particl counter. The lower the number of particles, the better the performance of the fabric/garment combination.

Spray Room

1. ***Paint Bleed Through:*** The measure of paint going through the fabric. The lower the better.

2. ***WVT and Air Porosity:*** WVT (water vapor transmission) and Air Porosity are tests that are used to meas the relative comfort of a fabric. WVT is the simulated measure of the amount of body moisture that will pass through a fabric in a 24-hour period. Air Porosity measures the volume of air, in cubic feet, that will pass thro a fabric in one minute. The greater the WVT and Air Porosity, the more comfortable a fabric will be; however, Porosity will be limited by Pore Size.

3. ***Pore Size:*** This test measures the average diameter of the interstices of a fabric in microns. Pore size can used to determine the maximum size of a particle that may pass through a cleanroom garment. Generally, th smaller the pore size, the better. Pore size is a good, relatively quick, measure of the filtration ability of a fabr but an even better test to measure the performance of a fabric in actual cleanroom usage is the Body Box te **See "How Should Fabric Filtration be Measured?" below.**

Contamination Control

1. ***Helmke Drum:*** This is a device used to count the number of available or releasable particles on a cleanro garment. Particles between 0.1 - 5.0 microns are the usual size of particles on a fabric. For cleanroom classification of fabrics/garments, released particles equal to or greater than 0.5 microns are counted. The lo the count of these particles, the better. The number of particles counted by the Helmke Drum can determine i the fabric has been properly laundered. It can also show if the fabric is degrading.

2. ***Static Decay and Surface Resistivity:*** These tests measure the electrical characteristics of ESD control fabrics for use in microelectronic environments. These fabrics are designed to provide a controlled release of electrical charge that will not damage sensitive circuitry. Static Decay is the speed of the charge-draining of materials. The faster the decay time, the better. Surface Resistivity measures the resistance of electrical flow over or through a fabric in ohms. The Surface Resitivity of fabrics used in ESD controlled areas should be between 105 - 1010 megaohms. The lower the Surface Resistivity (the closer to 105), the better a charge is dissipated, and the greater the ESD protection.

3. ***WVT and Air Porosity:*** WVT (water vapor transmission) and Air Porosity are tests that are used to meas the relative comfort of a fabric. WVT is the simulated measure of the amount of body moisture that will pass through a fabric in a 24-hour period. Air Porosity measures the volume of air, in cubic feet, that will pass thro a fabric in one minute. The greater the WVT and Air Porosity, the more comfortable a fabric will be; however, Porosity will be limited by Pore Size.

How Should Fabric Filtration be Measured?

PFE (Particle Filtration Efficiency) is a test used to measure the number of particles of a given size that will p through a fabric. The PFE test procedure is not performed in a controlled environment. Therefore, PFE testin has shown to not be comparable at different times/conditions and does not provide repeatable results. This invalidates any results generated from PFE testing. Pore size is a better measure of the size of particles that pass through a fabric. Pore Size measures the size of the interstices in a fabric and can be correlated with particle size. However, the Body Box test is the best measure of the performance of a fabric in actual cleanro usage. The Body Box test has been designed by the IEST-RP-CC-003.2 to test a fabric/garment combinatio The Body Box measures particles of specific sizes that are released as human subjects simulate routine

movements that may be encountered in a Cleanroom environment. The Body Box is designed to take into account the different particulation rates across a variety of subjects. Burlington Barrier fabrics have been evaluated across a random sampling of test subjects in a Class M1 Body Box that has been certified to captu 99.9% of all released particles. The M1 cleanroom classification is internationally accepted as the most stringent test environment.

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Cleanroom

Clean Room Fabric Chart

Delaney Uniform Service's cleanroom garments come in various fabrics:

BURLINGTON C3®

Burlington C3® is engineered to meet a Class 10 cleanroom's rigid demands for the microelectronics industry. The fabric is designed to guard the product against airborn particles, static dissipative charges, bacteria, and lint. It is made from a dense plain weave 100% multifilament polyester yarn with a microengineered carbon fiber inter-woven into a grid pattern.

- **Air Porosity**: 3.7 CFM
- **Surface Resistivity**: 10 to 100 megohms
- **Static Decay**: .01 Sec.
- **Chemical Resistance**: equal to 100% polyester

CHEMSTAT 909 SERIES®

Stern & Sterns CHEMSTAT 909 and 909A are two antistatic fabrics with a patented conductive yarn that is an extruded copolymer of polyester and carbon that is impervious to industrial laundering in excess of 300 washings. CHEMSTAT 909A is a tighter version of the CHEMSTAT 909 material for use in Class-10 cleanrooms. Both are 100% DACRON polyester fabrics employing the patented raised grid conductive fiber for static dissipation.

- **100% Polyester**: 3 oz/sq. yd.
- Weight: 3.00 oz/sq. yd.
- **Air Porosity**: 909A - less than 1.0 CFM/FT^2 ; 909 - 14.0 CFM/FT^2
- **Static Decay**: 0.5 sec

CHEMSTAT 919 SERIES®

Stern & Sterns CHEMSTAT 919 is composed of 100% multifilament NOMEX, an inherently flame retardent material with the same patented conductive grid as 909/909A.

- **Weight**: 5.00 oz/sq. yd.
- **Air Porosity**: 10.0 CFM/FT^2
- **Static Decay**: 0.15 sec

CHEMSTAT 949 SERIES®

Stern & Sterns CHEMSTAT 949 is a general purpose garment fabric designed for those cleanrooms or assembly areas where static is a primary concern but microcontamination is not. Aside from its use as a primary cleanroom garment is is also suited for use in building suits.

- **Weight**: 3.30 oz/sq. yd.

- **Air Porosity**: 25.0 CFM/FT²
- **Static Decay**: 0.02 sec

HERRINGBONE & TAFFETA POLYESTERS

DuPont's 100% Dacron polyester yarn is woven into both taffeta and herringbone weaves. Taffeta fabric is constructed in a plain weave while herringbone is a heavier broken-twill weave that produces a balanced zigzag effect. Both serve in many cleanroom and peripheral area applications as an effective barrier for airborn particles and bacteria filtration.

- **100% Dacron polyester**: Taffeta 2.58 oz/ sq. yd.- Herringbone 4.3 oz/sq yd
- **Excellent resistance to acids and alkalies**
- **Extremely limited tinting**
- **High resistance to sagging**

HIGH DENSITY TAFFETA

High Density Taffeta is a 100% polyester multifilament plain weave fabric. It was developed to provide long lasting barrier protection for fluid, bacteria, and particle penetration. Being lightweight and breathable ensures the technician's comfort in a Class 10 cleanroom.

- **100% polyester**: 3 oz/ sq. yd.
- **Air Porosity**: 1.56 CFM
- **Bacteria Filtration**: 100% resistant
- Spray Rating: 100%

INTEGRITY 1600®

INTEGRITY 1600® Precision Fabrics INTEGRITY 1600 is a densely woven filament DACRON polyester fabric containing an ESD stripe. INTEGRITY 1600 is designed for use as building suits worn in conjunction with the Integrity barrier fabrics. The fabric is treated with a durable antimicrobial and soil releasing finish for easy care.

- **Weight**: 2.65 oz/sq. yd.
- **Air Porosity**: 33 CFM/FT²
- **Mean Pore Size**: 30 microns
- **Static Decay** Warp : +0.12 sec 0.04 sec
- **Fill:** n/a

INTEGRITY 1700®

INTEGRITY 1700® Precision Fabrics INTEGRITY 1700" was developed to be the highest performing economical choice for less critical environments requiring a grid fabric. Integrity 1700" is manufactured using a proprietary process resulting in the lightest and most uniform fabric in its class.

- **Weight**: 2.60 oz/sq. yd.
- **Air Porosity**: less than 1.0 CFM/FT²
- **Mean Pore Size**: 8 microns
- **Static Decay**: Warp: - +0.01 sec -0.01 sec
- **Fill:** n/a

INTEGRITY 1800®

INTEGRITY 1800® ; Precision Fabrics INTEGRITY 1800" is a densely woven filament DACRON polyester striped fabric designed to meet the quality and performance standards demanded by the protective apparel industry. This product is highly fluid repellent and

also contains a durable antimicrobial compound.

- **Weight**: 2.67 oz/sq. yd.
- **Air Porosity**: less than 1.0 CFM/FT^2
- **Mean Pore Size**: 2 microns
- **Static Decay**: Warp - +0.01 sec -0.01 sec
- **Fill:** n/a

INTEGRITY 2000®

INTEGRITY 2000® Precision Fabrics INTEGRITY 2000"is a densely woven filament DACRON polyester grid fabric designed to meet the quality and performance standards demanded by the protective apparel industry. This product is highly fluid repellent and also contains a durable antimicrobial compound.

- **Weight**: 2.77 oz/sq. yd.
- **Air Porosity**: less than 1.0 CFM/FT^2
- **Mean Pore Size**: 1 micron
- **Static Decay**: Warp +0.01 sec -0.01 sec
- **Fill**: +0.01sec -0.01 sec

SELGUARD II BY TEIJINSELGUARD®

Teijinselguard Selguard II® is a highly functional Class 100 cleanroom fabric which offers both excellent particulate control and antistatic performance without compromising employee comfort. This non-linting fabric is a continous filament, 100% polyester twill with electrically conductive fibers sleeved in polyester and integrally woven into a grid design.

- **100% polyester**: 3.25 oz/sq. yd.
- **Air Porosity**: 34.5 CFM
- **Surface Resistivity**: Warp - 18 mohms/sq., Weft - 8.7 mohms/sq
- **Static Decay**: .01 sec
- **Chemical resistance:**equal to 100% Polyester

SELGUARD 110® by TEIJINSELGUARD

Teijinselguard Selguard 110 is a 100% polyester plain-weave fabric with a grid pattern of nylon electro-conductive yarn. Worn only as an undergarment, this Cleanroom-acceptable fabric is lightweight, soft, and extremely comfortable.

- **100% polyester**: 1.7 oz/ sq. yd.
- **Air Porosity**: 19.3 CFM
- **Surface Resistivity**: 30 mohms/sq.

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Designation: D ' ' - 96

Standard Test Method for Air Permeability of Textile Fabrics[1]

This standard is issued under the fixed designation D 737; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the measurement of the air permeability of textile fabrics.

1.2 This test method applies to most fabrics including woven fabrics, nonwoven fabrics, air bag fabrics, blankets, napped fabrics, knitted fabrics, layered fabrics, and pile fabrics. The fabrics may be untreated, heavily sized, coated, resin-treated, or otherwise treated.

1.3 The values stated in SI units are to be regarded as the standard. The values stated in inch-pound units may be approximate.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 123 Terminology Relating to Textiles[2]

D 1776 Practice for Conditioning Textiles for Testing[2]

D 2904 Practice for Interlaboratory Testing of a Textile Test Method That Produces Normally Distributed Data[2]

D 2906 Practice for Statements on Precision and Bias for Textiles[2]

F 778 Methods for Gas Flow Resistance Testing of Filtration Media[3]

2.2 *ASTM Adjunct:*

TEX-PAC[4]

NOTE 1—TEX-PAC is a group of programs on floppy disks available through ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

3. Terminology

3.1 *Definitions*—For definitions of other textile terms used in this test method refer to Terminology D 123.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *air permeability, n*—the rate of air flow passing perpendicularly through a known area under a prescribed air pressure differential between the two surfaces of a material.

3.2.1.1 *Discussion*—Air permeability of fabric at a stated pressure differential between two surfaces of the fabric is generally expressed in SI units as $cm^3/s/cm^2$ and in inch-pound units as or $ft^3/min/ft^2$ calculated at operating conditions.

3.2.2 *cross-machine direction, CD, n*—the direction in the plane of the fabric perpendicular to the direction of manufacture.

3.2.2.1 *Discussion*—This term is used to refer to the direction analogous to coursewise or filling direction in knitted or woven fabrics, respectively.

3.2.3 *fabric, in textiles, n*—a planar structure consisting of yarns or fibers.

3.2.4 *machine direction, MD, n*—the direction in the plane of the fabric parallel to the direction of manufacture.

3.2.4.1 *Discussion*—This term is used to refer to the direction analogous to warpwise or warp direction in knitted or woven fabrics, respectively.

4. Summary of Test Method

4.1 The rate of air flow passing perpendicularly through a known area of fabric is adjusted to obtain a prescribed air pressure differential between the two fabric surfaces. From this rate of air flow, the air permeability of the fabric is determined.

5. Significance and Use

5.1 This test method is considered satisfactory for acceptance testing of commercial shipments since current estimates of between-laboratory precision are acceptable, and this test method is used extensively in the trade for acceptance testing.

5.1.1 In case of a dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are from a lot of material of the type in question. Test specimens then should be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using the appropriate statistical analysis and an acceptable probability level chosen by the two parties before testing is begun. If a bias is found, either its cause must be found and corrected, or the purchaser and the supplier must agree to interpret future test results with consideration of the known bias.

5.2 Air permeability is an important factor in the performance of such textile materials as gas filters, fabrics for air bags, clothing, mosquito netting, parachutes, sails, tentage, and vacuum cleaners. In filtration, for example, efficiency is directly related to air permeability. Air permeability also can

[1] This test method is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General.

Current edition approved Feb. 10, 1996. Published April 1996. Originally published as D 737 – 43 T. Discontinued November 1995 and reinstated as D 737 – 96.

[2] *Annual Book of ASTM Standards*, Vol 07.01.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

[4] A PC program on floppy disk for Analyzing Committee D-13 interlaboratory data are available from ASTM Headquarters. For a 3½-in. disk, request PCN:12-429040-18. For a 5¼-in. disk, request PCN:12-429041-18.

01/10/2005 17:36 FAX 5162394951 APEX MILLS

be used to provide an indication of the breathability of weather-resistant and rainproof fabrics, or of coated fabrics in general, and to detect changes during the manufacturing process.

5.3 Performance specifications, both industrial and military, have been prepared on the basis of air permeability and are used in the purchase of fabrics where permeability is of interest.

5.4 Construction factors and finishing techniques can have an appreciable effect upon air permeability by causing a change in the length of airflow paths through a fabric. Hot calendaring can be used to flatten fabric components, thus reducing air permeability. Fabrics with different surface textures on either side can have a different air permeability depending upon the direction of air flow.

5.4.1 For woven fabric, yarn twist also is important. As twist increases, the circularity and density of the yarn increases, thus reducing the yarn diameter and the cover factor and increasing the air permeability. Yarn crimp and weave influence the shape and area of the interstices between yarns and may permit yarns to extend easily. Such yarn extension would open up the fabric, increase the free area, and increase the air permeability.

5.4.2 Increasing yarn twist also may allow the more circular, high-density yarns to be packed closely together in a tightly woven structure with reduced air permeability. For example, a worsted gabardine fabric may have lower air permeability than a woolen hopsacking fabric.

6. Apparatus

6.1 *Air Permeability Testing Apparatus*[5] consisting of the following:

6.1.1 *Test Head* that provides a circular test area of 38.3 cm^2 (5.93 $in.^2$) ± 0.3 %.

NOTE 2—Alternate test areas may be used, such as 5 cm^2 (0.75 $in.^2$), 6.45 cm^2 (1.0 $in.^2$), and 100 cm^2 (15.5 $in.^2$).

6.1.2 *Clamping System to Secure Test Specimens*, of different thicknesses under a force of at least 50 ± 5 N (11 ± 1 lbf) to the test head without distortion and minimal edge leakage underneath the test specimen.

6.1.2.1 A suitable means to minimize edge leakage is to use a 55 Type A durometer hardness polychloroprene (neoprene) clamping ring 20 mm (0.75 in.) wide and 3 mm (0.125 in.) thick around the test area above and underneath the test specimen.

NOTE 3—Since air leakage may affect test results, precautions must be taken, especially with very heavy or lofty fabrics, to prevent leakage. The use of a weighted ring and rubber gaskets on the clamp surfaces has been found to be helpful. Test Method F 778 describes a series of usable clamping adaptions to eliminate edge leakage. Gaskets should be used with caution because in some cases, and with repeated-use gaskets may deform resulting in a small change in test area. A weighted ring can be used with fabrics, such as knits or those that readily conform to the test head. The weighted ring is not recommended for lofty or stiff fabric.

6.1.3 Means for drawing a steady flow of air perpendicularly through the test area and for adjusting the airflow rate that preferably provides pressure differentials of between 100 and 2500 Pa (10 and 250 mm or 0.4 and 10 in. of water) between the two surfaces of the fabric being tested. At a minimum, the test apparatus must provide a pressure drop of 125 Pa (12.7 mm or 0.5 in. of water) across the specimen.

6.1.4 *Pressure Gage or Manometer*, connected to the test head underneath the test specimen to measure the pressure drop across the test specimen in pascals (millimetres or inches) of water with an accuracy of ±2 %.

6.1.5 *Flowmeter*, volumetric counter or measuring aperture to measure air velocity through the test area in $cm^3/s/cm^2$ ($ft^3/min/ft^2$) with an accuracy of ±2 %.

6.1.6 *Calibration Plate*, or other means, with a known air permeability at the prescribed test pressure differential to verify the apparatus.

6.1.7 Means of calculating and displaying the required results, such as scales, digital display, and computer-driven systems.

6.2 *Cutting Dies or Templates*, to cut specimens having dimensions at least equal to the area of the clamping surfaces of the test apparatus (optional).

7. Sampling and Test Specimens

7.1 *Lot Sample*—As a lot sample for acceptance testing, randomly select the number of rolls or pieces of fabric directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider the rolls or pieces of fabric to be the primary sampling units. In the absence of such an agreement, take the number of fabric rolls or pieces specified in Table 1.

NOTE 4—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between rolls or pieces of fabric and between specimens from a swatch from a roll or piece of fabric to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

7.2 *Laboratory Sample*—For acceptance testing, take a swatch extending the width of the fabric and approximately 1 m (1 yd) along the lengthwise direction from each roll or piece in the lot sample. For rolls of fabric, take a sample that will exclude fabric from the outer wrap of the roll or the inner wrap around the core of the roll of fabric.

7.3 *Test Specimens*—From each laboratory sampling unit, take ten specimens unless otherwise agreed upon between purchaser and supplier. Use the cutting die or template described in 6.2 or if practical, make air permeability tests of a textile fabric without cutting.

7.3.1 *Cutting Test Specimens*—When cutting specimens, cut having dimensions at least equal to the area of the clamping mechanism. Label to maintain specimen identity.

7.3.1.1 Take specimens or position test areas representing a broad distribution across the length and width, preferably along the diagonal of the laboratory sample, and no nearer the edge than one tenth its width unless otherwise agreed upon between the purchaser and supplier. Ensure speci-

TABLE 1 Number of Rolls or Pieces of Fabric in the Lot Sample

Number of Rolls or Pieces in Lot, Inclusive	Number of Rolls or Pieces in Lot Sample
1 to 3	all
4 to 24	4
25 to 50	5
over 50	10 % to a maximum of 10 rolls or pieces

[5] Suitable apparatus is commercially available.

mens are free of folds, creases, or wrinkles. Avoid getting oil, water, grease, and so forth, on the specimens when handling.

8. Conditioning

8.1 Precondition the specimens by bringing them to approximate moisture equilibrium in the standard atmosphere for preconditioning textiles as specified in Practice D 1776.

8.2 After preconditioning, bring the test specimens to moisture equilibrium for testing in the standard atmosphere for testing textiles as specified in Practice D 1776 or, if applicable, in the specified atmosphere in which the testing is to be performed.

8.3 When it is known that the material to be tested is not affected by heat or moisture, preconditioning and conditioning is not required when agreed upon in a material specification or contract order.

9. Preparation of Test Apparatus and Calibration

9.1 Set-up procedures for machines from different manufacturers may vary. Prepare and verify calibration of the air permeability tester as directed in the manufacturer's instructions.

9.2 When using microprocessor automatic data gathering systems, set the appropriate parameters as specified in the manufacturer's instructions.

9.3 For best results, level the test instrument.

9.4 Verify calibration for the range and required water pressure differential that is expected for the material to be tested.

10. Procedure

10.1 Test the conditioned specimens in the standard atmosphere for testing textiles, which is 21 ± 1°C (70 ± 2°F) and 65 ± 2 % relative humidity, unless otherwise specified in a material specification or contract order.

10.2 Handle the test specimens carefully to avoid altering the natural state of the material.

10.3 Place each test specimen onto the test head of the test instrument, and perform the test as specified in the manufacturer's operating instructions.

10.3.1 Place coated test specimens with the coated side down (towards low pressure side) to minimize edge leakage.

10.4 Make tests at the water pressure differential specified in a material specification or contract order. In the absence of a material specification or contract order, use a water pressure differential of 125 Pa (12.7 mm or 0.5 in. of water).

10.5 Read and record the individual test results in SI units as $cm^3/s/cm^2$ and in inch-pound units as $ft^3/min/ft^2$ rounded to three significant digits.

10.5.1 For special applications, the total edge leakage underneath and through the test specimen may be measured in a separate test, with the test specimen covered by an airtight cover, and subtracted from the original test result to obtain the effective air permeability.

10.6 Remove the tested specimen and continue as directed in 10.3 through 10.5 until ten specimens have been tested for each laboratory sampling unit.

10.6.1 When a 95 % confidence level for results has been agreed upon in a material specification or contract order, fewer test specimens may be sufficient. In any event, the number of tests should be at least four.

11. Calculation

11.1 *Air Permeability, Individual Specimens*—Calculate the air permeability of individual specimens using values read directly from the test instrument in SI units as $cm^3/s/cm^2$ and in inch-pound units as $ft^3/min/ft^2$, rounded to three significant digits. When calculating air permeability results, follow the manufacturer's instructions as applicable.

NOTE 5—For air permeability results obtained 600 m (2000 ft) above sea level, correction factors may be required.

11.2 *Air Permeability, Average*—Calculate the average air permeability for each laboratory sampling unit and for the lot.

11.3 *Standard Deviation, Coefficient of Variation*—Calculate when requested.

11.4 *Computer-Processed Data*—When data are automatically computer-processed, calculations are generally contained in the associated software. It is recommended that computer-processed data be verified against known property values and its software described in the report.

12. Report

12.1 Report that the air permeability was determined in accordance with Test Method D 737. Describe the material or product sampled and the method of sampling used.

12.2 Report the following information for each laboratory sampling unit and for the lot as applicable to a material specification or contract order:

12.2.1 Air permeability.

12.2.2 When calculated, the standard deviation or the coefficient of variation.

12.2.3 Pressure differential between the fabric surfaces.

12.2.4 For computer-processed data, identify the program (software) used.

12.2.5 Manufacturer and model of test instrument.

12.2.6 Any modification of this test method or equipment including changing or adding gaskets.

13. Precision and Bias

13.1 *Summary*—In comparing two averages, the differences should not exceed the single-operator precision values shown in Table 2 for the respective number of tests, and for fabrics having averages similar to those shown in Table 3, in 95 out of 100 cases when all the observations are taken by the same well-trained operator using the same piece of equipment and specimens randomly drawn from the sample of fabrics. Larger differences are likely to occur under all other circumstances.

13.2 *Woven Fabrics, Interlaboratory Test Data*—An interlaboratory test was run in 1994 through 1995 in which randomly drawn samples of three fabrics were tested in each of eight laboratories. Two operators in each laboratory each tested eight specimens of each fabric using this test method. Four of the eight specimens were tested on one day, and four specimens were tested on a second day. Analysis of the data was conducted using Practices D 2904 and D 2906 and the adjunct Tex-Pac. The components of variance for air permeability expressed as standard deviations were calculated to be the values listed in Table 3. The three woven fabric types were:

TABLE 2 Air Permeability, ft³/min/ft², Critical Differences^A for the Conditions Noted

Materials	Number of Observations in Each Average	Single-Operator Precision	Within-Laboratory Precision	Between-Laboratory Precision
Woven Fabrics				
Plain, Oxford spun yarns, Material 5	1	28.8	34.1	59.3
	2	20.3	27.4	55.7
	5	12.9	22.4	53.4
	10	9.1	20.5	52.8
Plain, spun yarns, Material 6	1	9.7	13.0	30.4
	2	6.9	11.0	29.6
	5	4.3	9.6	29.1
	10	3.1	9.1	29.0
Plain, continous filament yarns, Material 7	1	2.8	2.8	4.4
	2	2.0	2.0	3.8
	5	1.3	1.3	3.5
	10	0.9	0.9	3.4
Nonwoven Fabrics				
Hydroentangled	1	27.6	33.9	52.0
	2	19.5	27.7	48.2
	5	12.3	23.3	45.8
	10	8.7	21.6	45.0
Dry-laid	1	51.3	55.8	73.4
	2	38.3	42.1	63.6
	5	23.0	31.3	57.2
	10	16.2	26.8	54.9
Meltblown	1	8.8	9.3	21.5
	2	6.2	6.9	20.8
	5	4.0	4.9	20.0
	10	2.8	4.0	19.8
Needlepunch	1	100.7	112.4	113.4
	2	71.2	87.0	88.2
	5	45.0	67.3	68.8
	10	31.8	59.2	61.0
Resin-bonded	1	162.7	179.8	189.2
	2	115.1	138.1	150.1
	5	72.8	105.4	120.8
	10	51.5	92.0	109.3
Spun-bonded	1	234.6	234.6	251.2
	2	165.9	165.9	188.7
	5	104.9	104.9	138.1
	10	74.2	74.2	116.5
Thermal	1	206.2	232.3	232.2
	2	145.8	160.8	160.8
	5	92.2	141.2	141.2
	10	65.2	125.2	125.2
Wet-laid	1	1.34	2.80	3.24
	2	0.95	2.63	3.10
	5	0.60	2.52	3.01
	10	0.43	2.49	2.98

^A The critical differences were calculated using t = 1.960, which is based on [illegible] degrees of freedom.

Material 5—S/2438, Plain Weave, Oxford, Spun Yarns
Material 6—S/0002H, Plain Weave, Spun Yarns
Material 7—S/28305, Plain Weave, Continuous Filament Yarns

13.3 *Nonwoven Fabrics, Interlaboratory Test Data*—An interlaboratory test was run in 1994 in which randomly drawn samples of eight fabrics were tested in each participating laboratory. Two operators in each laboratory each tested eight specimens of each fabric using this test method. Four of the eight specimens were tested on one day and four specimens were tested on a second day. Analysis of the data was conducted using Practices D 2904 and D 2906 and the Adjunct Tex-Pac. The components of variance for air permeability of nonwoven fabrics expressed as standard deviations were calculated to be the values listed in Table 3. The eight fabric types and number of participating laboratories were as follows:

TABLE 3 Air Permeability, ft³/min/ft²

Materials	Grand Average	Components of Variance Expressed as Standard Deviations^A		
		Single-Operator Component	Within-Laboratory Component	Between-Laboratory Component
Woven Fabrics				
Plain, Oxford spun yarns Mat 5	217.[illegible]	10.4	6.6	17.5
Plain, spun yarns Mat 6	90.[illegible]	3.5	8.1	9.9
Plain, continous filament yarns Mat 7	8.[illegible]	1.0	0.0	1.2
Nonwoven Fabrics				
Hydroentangled	220.[illegible]	9.9	7.1	14.2
Dry-laid	402.[illegible]	18.5	7.7	17.9
Meltblown	72.[illegible]	3.2	1.0	7.0
Needlepunch	276.[illegible]	36.0	18.0	5.3
Resin-bonded	948.[illegible]	58.7	27.5	21.3
Spun-bonded	474.[illegible]	84.6	0.0	32.4
Thermal	564.[illegible]	74.4	36.6	0.0
Wet-laid	17.[illegible]	0.5	0.9	0.6

^A The square roots of the components of variance are being reported to express the variability in the appropriate units of measure rather than as the squares of those units of measure.

Nonwoven Material	Number of Participating Laboratories
Hydroentangled	5
Dry-Laid	5
Meltblown	5
Needlepunched	5
Resin-Bonded	2
Spun-Bonded	4
Thermal	4
Wet-Laid	5

13.4 *Precision*—For the components of variance reported in Table 3, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the critical differences listed in Table 2. There were sufficient differences related to the fabric type and structure to warrant listing the components of variance and the critical differences separately. Consequently, no multi-fabric comparisons were made.

NOTE 6—The tabulated values of the critical differences should be considered to be a general statement, particularly with respect to between-laboratory precision. Before a meaningful statement can be made about two specific laboratories, the amount of statistical bias, if any, between them must be established with each comparison being based on recent data obtained on specimens taken from a lot of fabric to the type being evaluated so as to be as nearly homogeneous as possible, and then randomly assigned in equal numbers to each of the laboratories.

NOTE 7—Since the interlaboratory test for resin-bonded nonwoven fabric included only two laboratories and the spun-bonded and thermal nonwoven fabrics included only four laboratories, estimates of between laboratory precision may be either underestimated or overestimated to a considerable extent and should be used with special caution.

13.5 *Bias*—The value of air permeability only can be defined in terms of a test method. Within this limitation, this test method has no known bias.

14. Keywords

14.1 air permeability; fabric

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